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The Relationship Between Ankle Joint Range of Motion and Position Sense in 18-50 Years Old Healthy Subjects in Zahedan

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The aim of this study was to evaluate the correlation between ankle joint mobility and position sense in healthy subjects of Zahedan city. This analytical study was performed in Zahedan city in 2003. Forty nine healthy subjects (25 men and 24 women) aging 33.14±9.4 year's participated through simple non-probability sampling. Active position sense of ankle joint plantar flexion was measured by electrogoniometer in two joint angles; 5 and 25 degrees. The ankle joint mobility (range of motion) was measured by goniometer. Pearson Correlations test were used to investigate the relationship between variables. There was no significant correlation between ankle joint mobility and angle matching error for 5 (p = 0/17) and 25 degrees (p = 0/48) angles. The results showed that there were no relationship between joint mobility and position sense in healthy men and women. Since muscle mechanoreceptors are one of the important factors of proprioception, any impairment in proprioceptive sense could be compensated by increase of muscle receptors activities.

Key words: Proprioception, position sense, ankle joint, mobility

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INTRODUCTION

Stability and mobility are necessary for efficient joint function. The joints needs to normal stability and mobility; increase or decrease in joint range of motion resulted in joint dysfunction (Greenman, 1996). Hypermobility was defined as joint laxity in total range of motion and lack of normal tissue resistance at the end of the range. There are two types of Hypermobility: general and local (Kessler, 1996; Russek, 1999). The ability of joint angle reproducibility at the end of the range in subjects with hypermobility with respect to normal subjects was decreased (Mallik *et al*., 1994). Joint receptors were destructed following hypermobility and therefore, joint afferents inputs were decreased. Joint laxity result in ligamentous and capsular stretching were delayed. Thus, joint receptors activities were decreased by this delay during motion (Laskowski *et al*., 2000). Orientation in regard to body position, movements and environmental changes was achieved through proprioceptive feedback. Contribution of position sense provides static stability of the body. If the proprioception was decreased, postural sways would increase (Kaikkonen *et al*., 1994; Lohrer *et al*., 1999). In subjects with joint hypermobility, discharges of joint mechanoreceptors may be decreased. Thus, subject feel that its joint positioned in middle range, while this is not accord with actual position of joint (Mallik *et al*., 1994). The proprioception is one of the determining factors of ankle joint stability. Ankle functional instability is usually due to coordinative deficit following diminution of proprioceptive inputs from joint mechanoreceptors (Iwasa *et al*., 2000; Friden *et al*., 1989; Hinterman, 1999). Balance of patients with respect to healthy subjects was reduced following proprioceptive deficits that were originated subsequent to ankle sprain (Lentell *et al*., 1995).

Garn and Newton (1988) studied on 30 subjects participated in various sports activities with recurrent sprain of ankle for detection of passive movement. Subjects in this study demonstrated grater awareness of passive motion in their uninjured ankle than in their sprained ankle. Subjects also demonstrated a higher frequency of balance deficits on the one legged standing balance test in the sprained ankle than in the uninjured ankle. Lentell *et al*. (1995) studied the contributions of proprioceptive deficits, muscle function and laxity to functional instability of the ankle and showed that significant impairment of passive motion sense into inversion across the sample of functionally unstable ankles compared with the contra laterals controls. The role of kinesthesia and anatomic stability compared to strength deficit in treatment of functional instability was more significant. Lohrer *et al*. (1999) on their study on the stable ankle joint without history of injury were described the neuromuscular and biomechanical adaptation of the ankle with respect to application two different adhesive tapes and to exercises. They showed that the tapped ankle compared to the unprotected ankle had a significant increase in the proprioceptive amplification ratio. However, proprioceptive activation by orthotic devices in the ankle joint similar to that occurring in the knee joint has often been postulated and the receptors of the skin, muscle and other parts of joint have at least an equivalent influence on proprioception. Postural regulation occurs on the basis of visual and vestibular influences but also through proprioception information from the muscle and skin of the sole of the foot.

Review of articles revealed that studies have focused on the joint injuries such as ligamentous tears, capsular rupture and subjects with hypermobile joints. As well, these studies were performed in the limited range of age and no study was reported to investigate the relationship between joint mobility and proprioception in healthy subjects. Thus, it is necessary to investigate the relationship between joint mobility and proprioception in both gender and extended age range. The purpose of this study was to find the relationship between proprioception with joint mobility and gender in healthy subjects.

MATERIALS AND METHODS

This cross sectional analytical study was performed in Zahedan in 2003. In this study, forty nine subjects ranging between 18 to 50 years old were recruited from healthy men and women of Zahedan city through simple non-probability sampling. Subjects were selected according to the following inclusion criteria: (1) lack of serious joint injury, serious systematic disease (cardiovascular, neuromuscular), psychological discomfort, perceptual and cognitive impairments, deformity and joint malformation, (2) lack of fractures, dislocation and surgery on the extremities in one recent year. Subjects were matched in two men and women groups in regard to their ages. Measures of outcomes will be obtained at follow-up appointments. General characteristics of subjects such as name, age, height, weight, job and sport activities were recorded in questionnaire. Active position sense of ankle joint and angle matching error during angles reproduction were measured by electrogoniometer. The questionnaire was completed according to inclusion and exclusion criteria by assessor. After case selection, an informed and written consent document was obtained from all participants. All of tests were done on the dominant side.

For ankle joint goniometric measurement three bony landmarks i.e., head of fibula, lateral malleoli and base of the fifth metatarsi were marked. Subjects were placed in sitting position and hip, knee and ankle joints in right angle. Axis of electrogoniometer was placed just below the tip of the lateral malleoli and arms were aligned along fibular head and fifth metatarsal prominence and were fixed with tape. The starting position for ankle joint testing was 90 degree. One of the two angles (5 or 25 degrees of plantar-flexion) was randomly selected by subjects. Then, the subject familiarization for proper test performance was achieved. The subject with closed eyes moved the ankle from starting position (90 degrees) to plantar-flexion (5 or 25 degrees) and reported at the target angle with word "yes". The subjects moved the ankle joint actively with constant speed during testing.

Total range of motion of the ankle joint was passively measured by ordinal goniometer. Total range of motion was included of plantar-flexion and dorsiflexion range. Methodological study was performed to determine interrater and intrarater reliability of the results. A sample with 16 subjects (8 men and 8 women) was selected. After marking the landmarks, active position sense tests in two 5 and 25 degrees of plantar-flexion were repeated two times. Interval between two repetitions was 48 h. Each of tests was performed by two raters. For bias control, active position sense and hypermobility tests were achieved by two different raters.

Statistical analysis: Data were analyzed using SPSS10. Intraclass Correlation Coefficients and Standard Error of Measurement were used to investigate the relative and absolute reliability, respectively.

RESULTS AND DISCUSSION

Results of absolute and relative reliability tests have been shown in Table 1.

Total range of motion were not significantly correlated with angle matching error in 5 ($p<0.17$) and 25 ($p<0.48$) degrees of plantar-flexion in both gender (Table 2).

Independent-samples t-test identified a significant difference between men and women with respect to mean of angle matching error in 5 ($p<0.001$) and 25 ($p<0.01$) degrees of plantar-flexion. The greater error in men showed that angle matching error was greater in men with respect to women in both angle (Table 3).

The findings showed that there was no relationship between mobility and active position sense of ankle joint. As well, active position sense of ankle joint in women was better than men. In present study active position sense was used to measure of proprioception.

Table 1: Relative and absolute reliability of total range of motion and angle matching error in 5 and 25 degrees of ankle plantar-flexion

	Absolute reliability		Relative reliability	
Variable	Two rater	One rater	Two rater	One rater
Angle matching error 5°	0.42	0.44	0.93	0.93
Angle matching error 25°	0.68	0.59	0.86	0.89
Total range	1.81	0.61	0.97	0.99

Table 2: Correlation between range of motion and angle matching error in 5 and 25 degrees of plantar-flexion

Variable		Total range of motion of ankle
Angle matching error	Pearson's coefficient	0.199
5 degree plantar-flexion	p-value	0.17
Angle matching error	Pearson's coefficient	0.103
25 degree plantar-flexion	p-value	0.48

Table 3: Comparisons of angle matching error in 5 and 25 degrees of plantar-flexion between men and women

Variable	Mean±SD (women)	Mean±SD (men)	Mean difference	P-value	t
Angle matching error 5°	0.58±0.46	1.47±1.08	0.89	0.001	-3.7
Angle matching error 25°	1.96±1.67	2.89±2.2	0.93	0.01	-1.7

Barrack *et al*. (1994) showed that muscle receptors were one of the determinant factors in proprioception. As well, another study was emphasized on the muscles role in assurance of proprioception (Brumagne *et al*., 2000). Inputs from joint tissues, muscles, skin, eyes and vestibular system were contributed in proprioception. According to previous studies, when active position sense was studied, muscle contributor component was activated following joint laxity (Burgess and Wei, 1982). Rozzi *et al*. (1999) suggested if we have any deficits in proprioception, it will compensate by increase in muscle mechanoreceptor activation level. In this study active position sense in healthy subjects without serious joint injury were investigated, whereas previous studies were performed in subjects with joint lesion (Laskowski *et al*., 2000; Lentell *et al*., 1995; Cordo *et al*., 1995).

Skin feedbacks following contact of tapes and measurement tools and also changes of resistance applied by electrogoniometer axis can help to find the target angle (Lohrer *et al*., 1999).

The comparison between both genders showed that active position sense in 5 and 25 degrees of plantar-flexion was better in women than men. The higher level of muscle receptors activity in women can contribute to increase functional stability for compensation of ankle joint laxity.

Since ankle joint mobility is higher in women than men, proprioceptive sense may be achieved following increase of muscle receptor activity. Subsequently, joint laxity will be compensated and joint functional stability will be increased (Rozzi *et al.*, 1999).

In spite of higher mobility of ankle joint in women with respect to men and based on review of previous studies and important role of muscle mechanoreceptors in proprioception improvement, our results revealed that in ankle joint higher activity of muscle mechanoreceptors resulted in improvement of active position sense (Warner *et al.*, 1996; Kelkar *et al.*, 1996; Swinkels and Dolan, 2000; Goodwin *et al.*, 1972; Brumagne *et al.*, 1999; Gandevia *et al.*, 1992; Roll *et al.*, 1982). The results of this study are only applicable in similar conditions, possibilities and properties. The further study needs for other aspects of this case.

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